# U.S. Department of Energy
# Renewable Energy Workshop and Business Development Study Tour

August 2004
Beijing, Baoding, Shanghai, and Inner Mongolia, China

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On August 1, 2004, DOE/NREL's Jean Ku and Kristin Stroup convened in Beijing with representatives of the U.S. renewable energy industry and key players in renewable energy development in the U.S. and China, for a two-day workshop and six-day study tour. The business development workshop and tour were sponsored by the U.S. Department of Energy (DOE) and the Chinese Ministry of Science and Technology (MOST). The Chinese Renewable Energy Industries Association (CREIA) coordinated the business development workshop and the study tour itinerary in Beijing, Baoding, and Shanghai. Charlie Dou of Beijing Bergey Windpower coordinated study tour activities in Inner Mongolia. The National Renewable Energy Laboratory (NREL) was the overall coordinator from the US side. Following are proceedings of the workshop and tour; post-tour U.S. industry developments are summarized on page 11.

U.S. industry was represented by:

- Alen Chang, Applications Marketing Engineer for United Solar Ovonic (Uni-Solar; Michigan)
- Charles Lee Cowden, President of Hanalei Solar (Hawaii)
- E. Patrick Jenevein III, President of Tang Energy Group (Texas and China)
- Chad Kabins, Energy Consultant/Manager for Mercury Solar and The Power Change Company (Hawaii)
- Marco Mangelsdorf, President of ProVision Technologies (Hawaii)
- Christopher Morley Paddon, CEO of Titanic Lifeboat Construction Network (Oregon)
- Bradley A. Zenger, President and CEO, Ecoworks and Senior Advisor to the China-U.S. Center for Sustainable Development (Oregon).
- Michael Mei, Foreign Commercial Service (Beijing)

Additional participants included:

- Christopher John Raczkowski, Juanli Han, Stephen Michael Terry, and Jason Kae Trollope of Azure International (Beijing)
- Ilan Gur, Rebecca Elizabeth Jones, Zachary M. Gentry, and Tom Du from the University of California at Berkeley.

### *The Village Power System Components Workshop: August 2, 2004*

The aim of this workshop was to discuss technical issues of renewable energy-based village power systems, which are used in China's National Township Electrification Program. Specifically, the workshop was organized to address various technical problems encountered in Chinese-manufactured inverters, charge controllers, and batteries used in village power systems, and to promote knowledge exchange between U.S. and Chinese experts. The workshop was organized by NREL and Beijing Jikedian Renewable Energy Development Center (JKD), and sponsored by DOE and MOST.

In addition to the U.S. industry representatives and participants listed above, fifty Chinese renewable energy industry representatives took part in this workshop; representatives from GTZ, IT Power, and GE were also present. Workshop presenters included Mark Fitzgerald from the Institute for Sustainable Power; Charlie Dou from Beijing Bergey Windpower; Liang Ji from Arizona State University's Photovoltaic Testing Laboratory; Ezra Auerbach representing Beacon Power and off-grid expertise; Chuck Whitaker from BEW Engineering Inc./Endecon Engineering; and Ma Shenghong from Jikedian Renewable Energy Development Center. In addition to a fruitful technical exchange, relationships between U.S. manufacturers and Chinese system integrators were developed. Workshop discussions revealed much interest for quality U.S. system component products in China. Details on the proceedings of the workshop are available in a separate document entitled *Village Power System Components Technology Workshop* at http://www.nrel.gov/international/china/workshops.html.

Following the workshop, Shi Lishan, Division Chief of the Energy Bureau of China's National Development and Reform Commission (NDRC), met with the U.S. study tour participants. He introduced the development of the PV market in China, especially in rural electrification applications, and took questions from the participants.

### *U.S.-China Renewable Energy Technology Exchange Workshop: August 3, 2004*

During the afternoon of August 3, U.S. study tour participants attended the *Sino-American Renewable Energy Technology Exchange Workshop,* organized by CREIA. Chinese participants included about 20 representatives from the PV industry, research institutes, and renewable energy consultancies, as well as renewable energy power system integrators.

Zhu Junsheng, president of CREIA, introduced the industrial development of renewable energy in China; major national policies; and the current market status of major renewable energy technologies in China, such as solar thermal, PV, wind, biomass, and geothermal energy. Barriers and opportunities in the Chinese market were also analyzed, which provided guidance for those U.S. participants new to China on how to conduct business in China. Chris Raczkowski, Managing Director of Azure International, presented his experience in business

development in China and raised for discussion a series of challenges that might face American businesses expanding into China, as well as corresponding solutions and recommendations. After the two presentations, a lively question and answer session ensued, and key issues regarding the current Chinese renewable market were discussed. The participants also discussed PV technology development trends and future production capacity. Taken together, these topics provided a clear picture of the developing renewable energy industry in China.

In break-out sessions which followed the workshop, representatives from Chinese PV companies and Chinese system integrators paired off with representatives from the U.S. companies to discuss business development and future opportunities for cooperation. Two of the major system integrators in China who are key players in the Chinese National Township Electrification Program, Beijing Jike Energy New Technology Development Company and Beijing Corona Science & Technology Co., Ltd, took part in the workshop and break-out sessions.

Over all, a valuable store of information on the Chinese renewable energy industry and market development was disseminated, and a cooperative bridge between Chinese and U.S. companies was established. The workshop provided U.S. participants with a basic understanding of the Chinese renewable energy industry and created a foundation for cooperation between U.S. and Chinese experts and industry leaders.

## *The Business Development Study Tour: August 3-8, 2004*

The objective of the Study Tour was to support U.S. companies interested in entering the Chinese market or expanding their current business there. Participants spent one morning in Beijing, one day in Baoding, two days in Shanghai, and two days in Hohhot and Pulitai, Inner Mongolia.

### *Beijing*

**Beijing Tianpu New Energy Comprehensive Utilization Demonstration Building.**

On the morning of August 3, participants of the delegation who were interested in solar energy and sustainable buildings visited the Beijing Tianpu New Energy Comprehensive Utilization Demonstration Building. The chairman of the board, Li Xianhang, and the chief engineer of Tianpu welcomed the delegation and made a presentation to introduce the demonstration building.

The building is one of China's National Research and Development Projects. The Chinese Academy of Sciences (CAS) and the Beijing Science Committee led the project. The implementation parties were Guangzhou Energy Research Institute (of CAS), the Institute of Electrical Engineering (of CAS), and Beijing Zhongkeneng Group.

The demonstration building has five floors, and the total construction area is 8000 $m^2$. It is a multi-function building, which includes a hotel, restaurant, entertainment venues, exhibitions, conference centers, and office space. The design idea of the building was to demonstrate new energy and comprehensive renewable energy utilization and follows energy efficient building standards. The building has five major features of energy utilization and energy efficiency: (1) solar energy air conditioning; (2) 1200$m^2$ solar energy collector system supports hot water and heating in winter; (3) a 50kW on-grid PV system supplies electricity; (4) a 1200$m^3$ underground water pool conserves energy; (5) a variety of building energy conservation technologies are combined for use in the building. The outside wall uses energy conservation material; energy efficient glass is used in windows; and water pipes are placed in the floors, walls and ceilings of the building for heating and cooling. Due to these new energy and energy efficiency technologies, this building saves 80% in energy compared to normal buildings in Beijing. After the presentation, the chief engineer of Tianpu led the delegation on a tour of the whole building to see the main equipment and facilities. .

**Huaneng New Energy & Environment Protection Corp. Ltd.**
Also on the morning of August 3, participants interested in the Chinese wind industry visited the headquarters of Huaneng New Energy & Environment Protection Corp. Ltd. (HNEEP) in Beijing.

HNEEP is a subsidiary wholly owned by China Huaneng Power Group. It was established in November 2002; the environmental protection segment of HNEEP has since been spun off into another entity. The company is primarily engaged in development of renewable energy power projects, including hydropower, wind energy, power generation from municipal solid waste, solar energy, and waste water treatment; in addition, the company is involved in the investment, development, production, construction, and operation of other new energy applications and environmental protection projects. The company is also involved in the sale of engineering and construction equipment, and the development, transferring, training, after-sales service and consultation of related technologies. The projects in which they have invested include: Shantou Huaneng Nan'ao Wind Power Co. Ltd., Dali Huaneng Hydro Power Co. Ltd., and Shitang Hydro Station. As a major player in the power sector, the company is quite active in developing wind energy in China. Current goals include developing wind farms in five Chinese provinces with a total installed capacity of 1.3GW. It is also working on a small PV pilot project.

The senior management of the company gave a brief introduction of their company and the wind market to the participants and then held a business discussion with them. HNEEP expressed a willingness to partner with foreign renewable energy project developers to increase project development and project finance expertise, as well as offset project investment costs.

**China Long Yuan Electric Power Group Corp.**
After the visit to Huaneng, the participants focusing on wind energy visited China Long Yuan Electric Power Group Corp. (Long Yuan).

Long Yuan was established in 1993 under the then State Power Company; it is now a subsidiary of Guodian Power Group. Most of Long Yuan's power plants are based on conventional energy, but in recent years, the company has placed more importance on the development of new energy

technologies and renewable energy. At present, Long Yuan is invested in five conventional energy power plants with a total installed capacity of 1600MW. Long Yuan has also established 18 wind farms with an installed capacity of 231.5MW, which comprises 41% of China's total installed wind farm capacity. Long Yuan was one of the first companies to engage in wind farm development in China. The company is currently working with UNDP to develop wind farms across eight provinces and with local governments to assess wind resources. It also has projects under development with the World Bank and GTZ. The company hopes to have 1.5GW of installed wind capacity by 2010.

The company is currently involved in five projects that are under construction: A 26MW project in Inner Mongolia and a 30.6MW project in Gansu Province that were to be operational by late 2004; a 20MW project in Shanghai (World Bank financed), a 14MW project in Tongshan, Hubei Province ( financed by Spanish government), and a 10MW project in Fujian Province to be operational sometime in 2005.

The vice general manager of the company, Mr. Zhang Yuan, introduced the company and its experience in wind farm development, then participated in a business discussion with U.S. representatives.

### *Baoding*

**Baoding Hi-Tech Development Zone**


On August 4, the delegation visited the Baoding Hi-Tech Development Zone. In the morning, all participants attended the *Sino-US Renewable Energy Project Conference* organized by the administrative office of the Zone. After opening remarks by the Vice Major of the Baoding Municipal Government, Ma Xuelu, the director of the Zone, gave an introduction to the Baoding Hi-Tech Development Zone. Following presentations by Jean Ku, China Project Leader of NREL and Michael Mei, Senior Commercial Specialist with the U.S. Embassy in China, U.S. participants provided a brief introduction to the group of their interests. A break-out business discussion session followed in which eight local Baoding companies, who were involved in renewable energy and/or interested in attracting foreign investment, knowledge exchange, and business cooperation, met with U.S. participants. These meetings provided a foundation for cooperation between several U.S. and Chinese companies, the current results of which will be summarized on page 11.

**Baoding Yingli New Energy Resources Company**

After the conference, the delegation visited Baoding Yingli New Energy Resources Company. Yingli is the largest comprehensive photovoltaic products manufacturer in China. The company introduced an entire set of advanced solar wafer, cell, and module production lines from Europe and the U.S., and is engaged in research, manufacture, sale and after-sales service (where applicable) of polycrystalline silicon ingot, wafer, cell, module, controller-inverter, PV system

and PV applied products. All of the ingot and wafer production equipment was purchased from a Swiss company, while the cell production line was purchased from GT Solar in the U.S. Their production capacity reaches 50MW annually and ranks in the top of the field in the world. The company owns 10800m$^2$ of workshops. The delegation visited the entire production line of the company and its products, and company experts answered questions from the participants. Marco Mangelsdorf of ProVision Technologies met with Yingli managers to discuss opportunities for international cooperation. (Group picture on page 1 was taken at Baoding Yingli.)

**Zhonghang (Baoding) Huiteng Windpower Equipment Co., Ltd**

Zhonghang (Baoding) Huiteng Windpower Equipment Co., Ltd was the next company visited. Huiteng is a U.S.-China cooperative enterprise, established and owned by Tang Energy Group, Ltd. (USA), Baoding Huiyang Aviation Propeller Factory, and China Aviation Gas-Turbine Power (Group) Corporation. Huiteng develops and manufactures a series of glass fiber wind turbine blades, and wind turbine components. The company was established in January 2001, and is composed of 120 employees. The construction area of the workshop is 6100 square meters, and it began operation in November 2002. The company's dominant product is a 600kW wind turbine blade, and the production scale can reach 200 sets per year. At present, the company is developing 750kW and 1MW+ wind turbine blades. The State Medium and Small Enterprise Fund subsidizes the 750kW blade development, and 1MW+ blade development is subsidized by the State High-Tech Research Plan (863 program). The experts of the company provided an introduction to Huiteng, its products and experience in wind blade manufacturing. Approximately 25 sets of blades were in inventory at the factory during the delegation's visit. The factory expected to produce about 70–100 sets of blades during 2004. The workshop and the completed blade products of the company were observed as part of the tour.

**Baoding TianWei Baobian Electric Transformer Group, Ltd.**
Following these company visits, the delegation visited the Baoding TianWei Baobian Electric Transformer Group, Ltd., which is one of the largest transformer and electric transmission system producers in China. The typical transformer range is between 115kV and 500kV. The company supplied transformers to the world's biggest hydro power station project at Three Gorges. It has expressed interest in becoming involved in manufacture of renewable energy technologies.

*Shanghai and surrounding area*

**Shanghai Topsola**
On August 5, participants interested in PV manufacture toured the Shanghai Topsola company and reviewed the company's manufacturing processes. The company manufactures polycrystalline PV cells, and a module fabricator. During the visit, there was no activity in the cell production process, but the module assembly process was operating. Cells from a company called "Q-Cell" were being assembled into modules with a capacity of about 160W each. At present, Topsola does not expect to enter the international market.

**Shanghai Jiaoda Taiyang Ltd. Co.**
On August 5, the delegation also visited Shanghai Jiaoda Taiyang Ltd. Co. Shanghai Jiaoda Taiyang Ltd. Co. is a comprehensive high-tech enterprise represented by Shanghai Jiao Tong University. The main business of the company is developing, manufacturing and selling products such as photovoltaic cells and modules, household and industrial photovoltaic power systems, solar thermal systems, and solar energy application products. The company produces several types of solar cells, thin-film technology, solar cell testers, solar garden lights, solar walkway lights, mobile solar chargers, and inverters and controllers for photovoltaic systems, all of which have been widely used in the field. Meanwhile, many projects in photovoltaic roof systems have been undertaken. The general manager of the company, Yin Shijian, briefly introduced their company, products, technologies and experience to the delegation, then invited the delegation to visit the production line of the company, and answered questions raised by participants of the delegation.

**Shanghai Energy Conservation Supervision Center**
The delegation was fortunate to meet Ms. Chen Rumei, Director of the prestigious center, and Mr. Lou Zhenfei, Vice Director. Conversation centered on urban transportation, the upcoming renewable energy law, and progressive policies in Shanghai.

**Suntech Power Co.,Ltd.**

On August 6, the participants involved in the PV industry traveled to Wuxi in Jiangsu province to visit Suntech Power Co., Ltd. The managing director of the company, Shi Zhengrong (pictured at right with Marco Mangelsdorf of ProVision), made a presentation to introduce the company and invited the delegation to visit their production line.

Suntech is a Sino-Australian company founded in 2001, which specializes in research, development, manufacturing and marketing of both single and poly-crystalline silicon solar cells and modules, and solar-powered products. Suntech has successfully developed products for both the domestic and overseas markets, exporting its products to Europe, the African Continent, and many countries in the Asia Pacific Region. In addition, it is poised to enter the U.S. market at present and has recently acquired UL certification. In the domestic market, Suntech's products are used in urban infrastructure, communication, petroleum and natural gas industries, transportation, lighting and architecture. Suntech's annual production capacity was 25MW as of November 2003 and increased to 50MW in 2004; the goal is to reach 300MW per year by 2007. Currently Suntech is accelerating its commercialization research of the high efficiency crystalline silicon solar cells. Suntech is considered China's leader in solar PV manufacturing in all aspects, including volume of cell and module production, technical capability, product exports, and ability to expand its business. Suntech does not currently have any wafer fabrication processes and is dependant on suppliers for this raw material.

Participants who were interested in seeking cooperation with the company had individual business discussions with Dr. Shi.

**Taicang Xintai Alcohol Co., Ltd.**

On August 6, a smaller segment of the delegation traveled to Jiangsu province to visit Taicang Xintai Alcohol Co., Ltd., a Singapore foreign-owned enterprise that produces alcohol products for the pharmaceutical and food industries. The purpose of the visit was to study the biomass project developed by the company. This project utilizes waste from alcohol production to generate biogas and the biogas is mainly used in alcohol production, such as fermenting and tank heating. Hangzhou Energy & Environmental Engineering Co., Ltd provided technological support to this project. The General Manager of the company, Hua Zhang, gave an introduction to the project and answered questions from the U.S. visitors.

The company has six large anaerobic fermentation tanks. After five years of effort and adjustment of the treatment process, the company is currently able to produce 32 cubic meters of biogas from each cubic meter of waste water, a great improvement over the original design.

Currently, the company produces 40,000 cubic meters of biogas per year. The company has two boilers used for producing steam for processing alcohol products, and the remaining steam after processing alcohol is used to generate electricity. Before the biogas was used to fuel the boiler, the boiler consumed 1.8 tons of coal in production of one ton of ethanol; now, the process consumes 40 tons less of coal every day—one third of coal usage has been replaced by biogas. The company has one biogas electricity generator, which they use when electricity from the coal/biogas boiler is insufficient. When this happens, all biogas produced is used to generate electricity with this biogas generator.

According to Mr. Zhang, the company is considering buying more biogas generators, in order to use only biogas to produce electricity for their own use and for possible sale back to the electrical grid.

*Inner Mongolia*

**Inner Mongolia Huade New Technology Company**

On August 7, the U.S. delegation visited the Inner Mongolia Huade New Technology Company (Huade) in Hohhot, the capital of Inner Mongolia. Huade's General Manager, Guo Xiaojian, met with the U.S. delegation and discussed the company's experience as an integrator for village power systems in the province.

Huade is owned by the Chinese government, and was established in 1993 as a Sino-German joint venture. Since that time, it has been primarily involved in research and development of PV and wind technology and system components, and project development in remote areas of Inner Mongolia. At the time of the U.S. visit, Huade had installed about 60 village systems and over 5,000 home systems, the majority of which were government-supported under China's Brightness Program. Huade is one of only 13 system integrators in China. Huade's general manager expressed interest in partnering with a U.S. PV company for pilot projects. After the meeting, U.S. participants toured Huade's manufacturing facility, pictured above.

**Inner Mongolia Polytechnic University (IMPU) New Energy Testing and Demonstration Base**

The U.S. delegation left Huade and traveled to a testing and demonstration center located just outside Hohhot, which is run by a local university, the Inner Mongolia Polytechnic University. IMPU and its Testing and Demonstration Base represent the hub of innovation in renewable energy technologies in the province, and the testing center provides a comprehensive overview of renewable energy development in Inner Mongolia, especially pertaining to rural electrification. Pictured below left, members of the U.S. delegation examine some wind turbines used in rural areas of the province; pictured below right is the testing center's model zero-energy home.

**Pulitai**

The following day, the delegation traveled to a rural area north of Hohhot, to a small remote village called Pulitai. The drive took about four hours and the road was paved for only the first portion of the drive. The U.S. delegation was able to experience the rural reality of China, meet some of the village residents, examine the village power system and discuss successes and challenges of its design, and enjoy an authentic Inner Mongolian meal home-cooked by the system's technicians.

The village is electrified by a mini-grid wind-solar system provided under China's Township Electrification Program.

### *Results of the August workshop and study tour: looking forward*

The study tour has proved beneficial for the U.S. participants and for U.S. industry in two ways. First, members of the U.S. delegation were able to establish connections among themselves, and several relationships have since formed between renewable energy system installers and distributors and the one U.S. PV manufacturer on the trip, United Solar Ovonic.

Second, several members from the U.S. delegation established relationships and, in a few cases, partnerships with companies in China. During the study tour, Marco Mangelsdorf of ProVision in Hawaii met with both Baoding Yingli and Suntech in Wuxi about distributing their PV panels in the U.S. Since those meetings, both Yingli and Suntech have achieved UL certification for distribution in the U.S.; Suntech is expected to start shipping products to the U.S. sometime in the spring of 2005.

In addition, Alen Chang of United –Solar Ovonic established a relationship with TianWei Baobian Electric Transformer Group when the U.S. delegation toured TianWei's facilities. TianWei expressed interest in manufacturing United Solar Ovonic products in China, and company representatives are expected to visit United –Solar Ovonic in the U.S. to pursue this venture sometime in 2005.

Over all, the business development workshop and study tour helped to form a strong foundation of cooperation and knowledge exchange not only between the U.S. and China, but also between representatives of the U.S. renewable energy industry. It is the goal of NREL's China Program to continue to foster these collaborative relationships in the future.